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ABSTRACT

Conditions under which the use of small groups in classrooms can be productive are suggested in this paper, which moves beyond the general question of small-group learning effectiveness. Part 1 offers a review of recent studies of interaction in cooperative groups, focusing on the following themes: interaction and achievement; task and interaction; the helpfulness of helping; interdependence and interaction; and reward interdependence. The second part examines factors affecting interaction, which include structuring the interaction, ensuring equity, and classroom influences. Implications for staff development and school organization are discussed in part 3, which examines the problem of assessment as a cross-cutting issue. A conclusion is that the central research question is "What kinds of interaction are necessary for different kinds of outcomes?" Research should take into account the following group conditions: task, solution, structure, and division of labor. Teacher training and followup are recommended for the utilization of cooperative learning. (106 references) (LMI)

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Restructuring the Classroom:

Conditions for Productive Small Groups

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Restructuring the Classroom:

Conditions for Productive Small Groups[1]

Elizabeth G. Cohen

Cooperative learning has gained increasing acceptance in classrooms here and abroad as a strategy for producing learning gains, the development of higher-order thinking, pro-social behavior, interracial acceptance, and as a way to manage academic heterogeneity in classrooms with a wide range of achievement in basic skills. Theoretically, small groups offer special opportunities for active learning and substantive conversation (Nystrand, 1986) that are essential for authentic achievement, a goal recommended in the current drive to restructure schools(Newmann, 1991). Small groups have also been widely recommended as a means to achieve equity(Oakes & Lipton, 1990).

The earliest reviews of research on cooperative learning were mainly concerned with its effectiveness in comparison to traditional forms of instruction that are more competitive and/or individualistic(Sharan, 1980; Slavin, 1980). These early reviews concluded that, in general, there were some significant positive effects on achievement and interracial relations that occur as a

[1]The author is indebted to Courtney Cazden for her help with the literature and her feedback on small group discourse. The criticism and comments from the reviewers, Steven Bossert and Neil Davidson, as well as those from Adam Gamoran and Fred Newmann were also of great value.

result of cooperative learning. In some studies, however, cooperative learning was associated with results that were merely as good as those with more traditional forms of instruction and not necessarily superior. As research continued to accumulate, Davidson (1985) in a review of studies on the use of small groups in mathematics education, found significant differences favoring cooperative over traditional methods of instruction in a third of the studies; the remaining studies showed no significant differences according to type of instruction. Moreover, the results of cooperative learning sometimes differed according to the ethnic or racial group of the student (Kagan et al., 1985). Bossert(1988) characterizes the more recent meta-analyses on the now substantial body of research as suggesting that the benefits of cooperative learning activities hold for students at all age levels, for all subject areas, and for a wide range of tasks, such as those involving rote-decoding, retention, and memory skills as well as problem-solving ability(Johnson, Johnson, and Maruyama, 1983; Johnson, Maruyama, Johnson, Nelson, & Skon, 1981). In contrast, Slavin (1983) argues in a "best evidence" synthesis that cooperative learning is only effective when group rewards and individual accountability are present. A second synthesis of "best evidence" taken from studies of secondary schools only(Newmann, & Thompson, 1987) concluded that of the 37 comparisons, 68% favored cooperative learning over traditional forms of instruction. The outcome measures used in these studies were almost exclusively made up of items measuring recognition, recall, and use of algorithms.

This variability in findings suggests that the advantages that can theoretically be obtained from cooperative learning can actually be obtained only under certain conditions. The purpose of this review of research is to move beyond the general question of effectiveness of small group learning to the attempt to conceptualize conditions under which the use of small groups in

classrooms can be productive. In his 1988 review of research on cooperation, Bossert was highly critical of the lack of knowledge about the ways in which various cooperative activities produce their positive effects. He was particularly critical of studies that employ a "black box approach" in which they compare a cooperative instructional method to a non-cooperative method on outcome measures alone. A thorough search of the recent research literature reveals that numerous studies have progressed beyond this black box approach to one in which various features of cooperative learning are manipulated so as to highlight the importance of particular conditions for success on different kinds of instructional outcomes. In addition, there are many observational studies examining the process of interaction within the small groups and relating interaction variables to outcome measures. Although much of this research does not contain powerfully developed theoretical frameworks, we will build on these findings to develop several testable propositions concerning the conditions for productive small groups.

Some Definitions

For the purposes of this review, cooperative learning will be defined as students working together in a group small enough so that everyone can participate on a collective task that has been clearly assigned. Moreover, students are expected to carry out their task without direct and immediate supervision of the teacher. The study of cooperative learning should not be confused with small groups that teachers often compose for the purpose of intense, direct instruction, e.g. reading groups. This definition is both broad and sociological in character. For the purpose of a fresh examination of the research literature, we have chosen a definition which encompasses what is sometimes distinguished as collaborative learning, cooperative learning, and groupwork..

In moving away from the issue of whether or not cooperative learning is effective, it is

essential to distinguish the different meanings of productivity or effectiveness for this instructional strategy. Techniques that are effective for one outcome variable may well be ineffective for another. The commonest definition of productivity for cooperative learning has been conventional academic achievement, of the kind that standardized achievement tests have measured in the past. This type of achievement stresses basic skills, memorization of factual materials, and the application of algorithms in areas such as mathematics.

Other researchers advocate small groups because they believe that small-group-processes contribute to the development of higher-order thinking skills(Noddings, 1989). Noddings sees this school of thought as originating in the work of Dewey and the social constructivism of Vygotsky(1978). Because these researchers assume that such outcomes cannot be achieved without the creation of suitable discourse or conversation within the small groups or without a process of discovery, they define productive small groups as those that are engaged in high-level discourse. This alternative definition of productivity stresses conceptual learning and higher-order thinking. Some parts of standardized achievement tests do attempt to measure these outcomes; other researchers have created instruments to capture this type of learning.

For those researchers concerned with equity, productivity is defined as the occurrence of equal-status interaction within the small groups. This is typically measured by comparisons of individual rates of participation for students of different statuses within the group. It is also possible to define productivity in this domain at the classroom level, e.g. those classrooms in which there is very little difference between the participation rates for students of differing statuses within cooperative groups are more productive.

Finally, productivity may be defined in terms of desirable pro-social behaviors such as

being cooperative or being friendly towards students of a different ethnic or racial group. Related to this type of outcome is a concern for the use of cooperative learning in a multiethnic setting. In this case, productivity is defined as positive intergroup relations.

Theoretical Focus of the Review

A major focus of this review is on interaction within small groups engaged in cooperative learning. Researchers have exhibited a good deal of interest in interaction, particularly in the question of what features of the interaction make for favorable learning outcomes. A central proposition of this review is that the relationship of interaction to achievement differs according to the nature of the task assigned to the group. Not all tasks assigned to cooperative groups are true group tasks. Some could be done as individuals and have the character of collaborative seatwork. In addition, some tasks have fairly clear procedures and may have "right answers," whereas others are what the sociologists call "ill-structured problems." Theoretically, interaction should be far more critical for achievement gains when there is an ill-structured problem that is a true group task than when the task is more clear cut and could be carried out by individuals.

Both the applied researcher and the practitioner would do well to focus directly on the type of interaction that is desired. There is, for example, a major difference between the type of interaction useful for the more routine types of academic learning and the type of interaction desired when the objective is learning for understanding or conceptual learning. For more routine learning, students may help each other to understand what the teacher or the textbook is saying and may offer each other substantive and procedural information. For conceptual learning, the interaction should be more of a mutual exchange process in which ideas, hypotheses, strategies and speculations are shared. If the objective extends to verbal reasoning and/or written or oral

argument, then one would want to see a kind of interaction that included articulation of reasoning and a verbalization of thinking processes.

Once the desired type of interaction has been specified for particular objectives, there are a number of factors that will affect how well this desired interaction is achieved. For example, if the main type of interaction desired is for students to offer each other assistance, then the motivation of students to do so, as well as the preparation for constructive assistance of one another, become important factors in predicting the relative success of the groups. If, on the other hand, an extensive mutual exchange of ideas and strategies is desired, then too sharp a division of labor or limited participation of low-status students may impede the very interaction necessary for the achievement of conceptual learning.

The discussion of specific studies is divided into three parts. The first part examines research on interaction and its relationship to productive small groups under varying task conditions. Having established the importance of interaction for attaining educational objectives under specified conditions, the second part focuses on factors that affect interaction. For example, if the major type of exchange is one of providing assistance, then there is research documenting the effectiveness of closely specified roles and interaction strategies. Those very same techniques may be counterproductive for more conceptually oriented and elaborated discussion, where participants are attempting to solve problems with ill-structured solutions.

The third part moves to the organizational context of cooperative learning and deals with issues of staff development and organizational support for teachers. Here too, the findings appear to be conditional; they depend upon the complexity of the methods of cooperative learning that are being implemented. Collaborative seatwork with more routine subject matter may require

much less intensive staff development and organizational support than modes of cooperative learning featuring discovery and authentic discourse.

With a focus on interaction, task arrangements and productivity, the perspective taken in this review is social psychological and organizational. There is a reexamination of problems that have been debated for some time among researchers on cooperative learning. The hope is that by choosing to focus primarily on interaction rather than on interdependence, rewards and individual accountability, new light will be shed on some old problems. Rather than continue the current debate over which of the popular methods of cooperative learning are more effective, a less holistic mode of analysis is used to examine the evidence for each of the selected variables. For this purpose, studies that compare the common methods of implementing cooperative learning are not the most useful because they typically differ on several of the key factors at once.

In describing and analyzing relevant research, more general proposition are inferred, where possible, about conditions under which small groups will be more productive. It is these general propositions that comprise recommendations for future research. The propositions are based on a post hoc analysis of the research literature and its contradictions. Future researchers would do well to put these propositions to a new and general test.

Collection of articles. The search of the literature was restricted to empirical research or to reviews of research and did not tap into the large literature written for practitioners on this subject. Eliminated were studies that contrasted a cooperative treatment to some kind of a control treatment; selected were those studies or parts of studies that contrasted alternative forms of cooperative learning or those studies that focussed on the small-group-processes within cooperative learning groups. Also omitted were studies of peer response groups in the teaching

of writing, peer tutoring, and studies of college-age students. Most of the studies selected for review took place in classrooms. A number of laboratory studies were dropped from consideration on the grounds that the experimental task bore no resemblance to a school task. A few laboratory studies were included because they used more applicable tasks and highlighted the effects of one of the factors under consideration. If the methodology were so grossly flawed that very little could be learned from a study, it was not included. Included are a number of modest qualitative studies of relatively few groups, detailing the nature of group interaction. The choice of which studies to include was dictated by the purpose of developing general propositions. Great care was taken to include studies that did not support the general propositions under development. Most of the relevant literature meeting these criteria was written in the 1980's.

Part I

Studies of Interaction

There are available a number of studies that have examined in-depth the nature of interaction taking place within cooperative groups. The typical design of these studies paid relatively little attention to the nature of the task assigned to the groups. Moreover, students were given no special preparation for cooperative behavior. Students were typically instructed to work together, but there were no further attempts to structure interaction because the goal was to study "natural" cooperation.

Barnes and Todd(1977) carried out the pioneering study of this type, recording detailed conversations of students engaged in a variety of creative problem-solving tasks. Many of their conclusions based on a qualitative analysis of the interaction foreshadowed issues that were to

become central to the research of the 80's. These included the nature of understanding that emerges from the group, the kinds of social and cognitive skills required of students for effective interaction, and the effects on interaction of variations in the type of task given to the group.

The transcripts from this study include some of the best examples in the literature of the social construction of knowledge. For Barnes and Todd, the meaning of a given contribution to the group members, was often gradually negotiated through the interaction process. They cautioned researchers that meaning may not be explicit even to the speaker in an ongoing discussion, because criteria for relevance are negotiated moment by moment. Only when the conversation is over, by looking backwards, can a determinate meaning be assigned. These investigators made a distinction between operational meaning of the moment and subsequent reflective meaning.

Some of the groups studied by Barnes and Todd were far more effective than others. Useful behaviors included soliciting opinions, encouraging explicitness, pinpointing differences and interrelating viewpoints. Some groups engaged in destructive interaction in which members were verbally attacked. These revealing transcripts produced the conclusion that students needed both social and cognitive skills for effective interaction. The social skills required included the ability to control progress through the tasks, the skills to manage competition and conflict, and the ability to modify and use different viewpoints as well as the willingness to give mutual support. Cognitive skills included constructing meaning for a given question, inventing a problem, setting up hypotheses, using evidence and recreating experience.

Differences in the transcripts between groups carrying out different tasks led to the observation that the degree of unfamiliarity of the task to the students should be considered so

as to keep the amount of uncertainty manageable. Other task dimensions that the investigators saw as important were how loosely or tightly structured was the task and whether there was one or multiple solutions to the problem. They also mentioned that having some concrete object for students to manipulate could make a difference in the effectiveness of the group.

Schwartz, Black, and Strange(1991) also take a constructivist view in trying to answer the question of why dyads are far more effective than individuals in inducting a general rule concerning a physical problem of the effects of multiple gears . Based on a study of interaction of dyads, they conclude that working in pairs required subjects to create an agreed-upon representation of the problem in order to communicate with each other. This representation allowed the group to abstract more successfully than single individuals. They recommend that cooperative learning should capitalize on the unique strengths of group learning by selecting tasks that involve abstractions and require and enable representational negotiation.

In contrast to these social constructivist views is the conclusion of Chang and Wells(1987) that in order to be effective, groups must manage the process of solving problems with explicit talk. They define learning as problem-solving where the planning and execution of tasks is brought under conscious control. Groups support this process by making thinking explicit and available for inspection and revision. To work together, students have to specify goals more precisely, plan procedures, generate and select alternatives, and review or modify their plans. This problem-solving model de-emphasizes the ongoing social nature of understanding.

Vedder(1985) also sees effective cooperative learning as a result of an explicit process. According to the theory of cooperative learning he developed from a more general view of teaching and learning, the children's role vis a vis each other should be that of teacher and pupil.

For cooperative learning to be effective, Vedder reasoned that pupils must control and evaluate their partner's work. Also, help that is given should correspond to a model of a correct problem-solving process. After finding that cooperative groups did no better than the control condition on a set of geometry lessons, he performed an in-depth analysis of videotapes to see if students were actually regulating each other's problem-solving process. The pupils in the cooperative condition were taught how to regulate each other's solving of geometry problems. The analysis revealed that the students were fixated on finding the right answers which interfered with their attempting to regulate each other's process of problem-solving. They spent little time in thinking and talking about problem-solving strategies. They hardly used the resource card that contained useful information on problem-solving strategies.

Vedder was not the only researcher to be disappointed with the level of discourse that takes place in cooperative groups. In a study of small groups of students(ages 11 through 14) working with a computer and learning BASIC programming, Webb, Ender and Lewis(1986) found that students performed all of their debugging statement by statement at the lowest abstract level. There was little long-range planning. Only with help from the instructor were they able to carry out plans at a more abstract level.

These studies suggest a useful generalization: If students are not taught differently, they tend to operate at the most concrete level. If teachers want high-level operation, particularly verbal, the students will require specific development of skills for discourse, either in advance of cooperative learning or through direct assistance when groups are in operation. The transcripts of Barnes and Todd suggest a similar proposition concerning interpersonal skills. These are not an automatic consequence of cooperative learning. Either through some kind of motivational

device or deliberate instruction in these social skills, something must be done to provoke the desired behaviors within cooperative groups.

Interaction and Achievement.

There is an extensive literature that correlates observed interaction within cooperative groups with achievement, holding constant prior academic achievement. This literature presents a most interesting inconsistency, permitting the derivation of a general proposition concerning the conditions under which interaction will be related to achievement gains. On the one hand, there is a large body of meticulously conducted studies showing that the simple frequency of interaction on the part of individual students does not predict their achievement. Noreen Webb who is the investigator in many of these studies has also written several excellent reviews of this literature(1983, 1991). Most of these studies were conducted in mathematics classes where students were given problems to solve and were told to work together as a group, helping each other, and asking the teacher for help only when no one in the group could assist.

In contrast to this body of work, stand a number of studies conducted on complex instruction in multilingual elementary classrooms. Complex instruction features open-ended, discovery or conceptual tasks that emphasize higher-order thinking skills. In these studies, Cohen and her colleagues consistently find that simple measures of frequency of task-related interaction are related to gains on computation and mathematical concepts and applications as well as on content-referenced tests. These results hold regardless of whether the unit of analysis is the individual learner or the percentage of students who are observed talking and working together in the classroom(Cohen & Intili, 1981; Cohen, Lotan, & Leechor, 1989). At the individual level, Cohen (1984) found that the frequency of students talking and working together in a task-related

manner was positively correlated with the post-test scores on a content-referenced test in science, while holding constant the pre-test scores. This same variable of talking and working together had an independent effect on individual worksheet performance, as measured by quality of writing about results, conceptualization in mathematics, and inference (Stevenson, 1982). In an analysis of achievement on standardized tests of mathematics, Leechor(1988) concluded that task-related talk was a significant predictor of gains in mathematics for students who have reading scores at grade level or above as well as for students whose reading scores are below grade level. However, the linear correlation of participation with learning was more consistent in the low-achieving group than in the high-achieving group.

Task and Interaction. What differences between these two bodies of studies could account for the differential effectiveness of simple interaction? The first difference lies in the working relationships between the group members. In the case of the group assignments in mathematics and the tasks given to the computer groups, the tasks could have been carried out by individuals. They were not inherently group tasks. A group task is a task that requires resources (information, knowledge, heuristic problem-solving strategies, materials and skills) that no single individual possesses so that no single individual is likely to solve the problem or accomplish the task objectives without at least some input from others(Cohen B. & Arechavala-Vargas, 1987). The tasks used in complex instruction fit this definition of a group task. When working on a group task, members are interdependent in a reciprocal fashion. In other words, each actor must exchange resources with others before the task can be completed. This contrasts with many routine tasks used in cooperative learning where achievement depends on the stronger students helping the weaker students. This arrangement is also interdependent, but the interdependence

is sequential as opposed to reciprocal e.g. one student's performance is dependent upon another's, but the reverse is not true.

In the case of complex instruction, reciprocal interdependence is also produced by the system of classroom management in which each student is responsible for helping to insure the success of all members. Each student has a role that has to do with the functioning of the group. Moreover, the students experience a week of skillbuilding activities in which they internalize norms of mutual assistance. Lastly, specific steps are taken to prevent the better students from doing all the helping and weaker students from accepting all of the help (Cohen, B., & Cohen, E.G., 1991). In the studies reviewed by Webb, there was no such system of classroom management nor was there any special training for cooperative relationships.

The second important difference lies in the nature of the work assigned to the groups. Computational or algorithmic mathematics assignments typically have a right answer that can be reached in well-structured ways while open-ended and discovery tasks such as those used in complex instruction do not have one right answer and are ill-structured problems; they are non-routine problems for which there are no standard recipes or procedures. Under the conditions of a group task and an ill-structured problem, interaction is vital to productivity. In the case of a classroom setting, productivity is often defined in terms of achievement gains(See the first two definitions of productive small groups above.). Unless the group members exchange ideas and information, they are unlikely to come up with creative solutions to their assignment or to discover underlying principles. This may be stated as a more general proposition:

> Given an ill-structured problem and a group task, productivity will depend upon interaction.

More specifically: given a problem with no one right answer and a learning task that will require all students to exchange resources, achievement gains will depend upon the frequency of task-related interaction.

If general measures of interaction do not predict achievement when students are working on conventional school tasks with well-defined procedures that could be carried out as individuals, what does? The most consistent positive predictor of achievement in these studies is the giving of detailed, elaborated explanations(Webb, 1983, 1991). In other words, the student who does the explaining is the student who benefits, controlling for how well he or she would have done based on past achievement/ability. Swing and Peterson(1982) also found that high-achievers benefitted from participation in heterogeneous groups, especially through giving explanations to others. Moreover, students with higher initial achievement/ability scores tend to give more explanations.

Giving of more detailed explanations is, in turn, related to the student's conception that better explanations are those that include specific content or information (Peterson, & Swing, 1985). These concepts of a good explanation are significantly related to group achievement on seatwork, with arithmetic tasks (Peterson & Swing, 1985).

The importance of giving explanations as a predictor of achievement gains did not hold up in studies of microcomputer learning. Webb summarizes the results of her first microcomputer study:

> The importance of specific verbal interaction variables for learning was less in this study than in previous studies of small-group work in the classroom. In the present study in contrast to nearly all previous studies, giving explanations did not help students to learn

computer programming. Receiving explanations found in some previous studies to be beneficial for learning, influenced only learning of the basic commands.(Webb, 1984a, p.1086).

Similarly, in a subsequent study of students learning BASIC, Webb and her colleagues (Webb, Ender, & Lewis, 1986) found that giving explanations was not a predictor and that receiving explanations related to knowledge of commands, but not to interpreting programs or to ability to generate programs.

Some of the favorable effects of giving explanations may stem from what Fletcher(1985) calls "cognitive facilitation." In a computer task calling for solving equations in an earth spaceship game, individuals who were told to verbalize their decisions did as well in problem-solving performance on the game as groups told to come to consensus (Fletcher, 1985). Both these conditions had superior results to those found for individuals working silently. There is parallel evidence of the favorable effects of cognitive facilitation at the group level. King(1989) formed groups of fourth graders who were provided with video-tape modeling of "think-aloud problem solving". The group task was to reproduce a stimulus design using LOGO computer graphics. Groups were instructed to think aloud as they performed their task. More successful groups asked more task-related questions, spent more time on strategy, and reached higher levels of strategy elaboration than did groups who were less successful on the task.

The Helpfulness of Helping. How helpful are these elaborated explanations to the students who receive them? Receiving content-related explanations produced positive effects on achievement in only three of the 14 partial correlations in the studies surveyed(Webb, 1991). However, if students receive no answer when they request help, they clearly learn less than if

they do get a response. Receiving no response to a request for help or a terminal response in which one is only given the right answer is consistently negatively related to achievement (Webb, 1991).

Webb(1991) points out that more important than the kind of help that a student receives is the match between the student's request for help and the kind of response received. For example, receiving less elaboration than is needed, such as asking for an explanation and being told only the correct answer, is negatively related to achievement. Navarrete(1985) also studied sequences of behavior surrounding help. The frequency of a sequence consisting of a student requesting help, receiving help, and returning to his or her task predicted gains in reading comprehension, while incomplete sequences such as receiving help without having asked for it or receiving no help when requesting it were unrelated to achievement.

Whether or not a student receives needed help has something to do with the nature of the request for assistance. Webb(1991) cites numerous studies that have found that specific requests are more successful than others in eliciting appropriate and adequate responses. The most extensive work on this subject has been done by Wilkinson and her colleagues (See, for example, Wilkinson & Calculator, 1982).

Low-achievers undoubtedly are helped in the course of the interaction within cooperative groups in many ways outside of specific requests for help and adequate responses to those requests. Future research would do well to develop an understanding of the several different ways in which interaction in heterogeneous groups proves effective in assisting the learning of the low-achiever. Available research often focuses on the fact that groups are heterogeneous or homogeneous with respect to achievement rather than on the nature of the interaction that occurs

in the context of these two different kinds of groups.

Most models of cooperative learning advocate the use of heterogeneous groups because of the hypothesized benefits to low-achieving students of receiving instruction from high-achieving students or because of the desire to increase trust and friendliness between members of different social groups. There is considerable support in the research for the beneficial effects of heterogeneous groups on low-achieving students. Some researchers have focussed specifically on this question of the effectiveness of heterogeneous vs. homogeneous group composition. In studies of collaborative seatwork, Swing and Peterson(1982) found that students of low achievement benefitted from participation in groups heterogeneously composed on achievement in comparison to participation in homogeneously low-achieving groups. Students of average achievement were the only ones not to benefit from their interaction with others of higher or lower achievement. They did better in homogeneous groups of average achievers.

In a study of homogeneous vs. heterogeneous groups working on a computer-driven tutorial that did not relate to their work in the regular math classes, Hooper and Hannafin(1988) also report that low-achieving eighth grade math students benefitted from working with high-achieving students on a delayed post test with questions covering factual recall, application, and problem solving. There were no differences in test performance by group composition; and group composition had little effect on the performance of high-achieving math students. The favorable effects for the low-achievers were restricted to the factual recall questions and not to the parts of the test that required higher level problem solving. Although Hooper and Hannafin wonder whether the higher-level problem solving was inappropriate for the ability level of these students, it should be noted that the high-achieving students also did much worse on the application and

problem-solving parts of the test than they did on factual recall. An alternative explanation for the failure of the cooperative learning to lead to gains in higher-order thinking were the task instructions which had the students alternating roles of decision-maker, and advisor, or typist/advisor for every five questions. This sharp division of labor may have inhibited the type of interaction necessary for these more ill-structured problems.

There is evidence that lower-achieving students are benefitted by interaction with higher-achieving students even when tasks demand higher-order thinking. Children paired with a partner who had used a higher-level cognitive rule on the pre-test were significantly benefitted and were able to function at a higher cognitive level on the post-test than on the pre-test(Tudge 1990). Tudge (1990) concluded that it was exposure to high-level reasoning that made a difference as to whether a student would learn from another of greater competence. "When the children's partner supported their predictions with reasoning at a higher level than that used by the target children, the latter were highly likely to improve." These effects of treatment conditions did not vary by age group; the study included pairs of kindergartners to fourth-graders. By the same token, exposure to less-advanced reasoning in the course of interaction can have a negative effect on more developmentally advanced children. On a very challenging mathematical balance beam task(Tudge, 1991), selected pairs homogeneous or heterogeneous as to the level of cognitive development they exhibited on a pre-test on this task. Partners who were using more advanced rules to solve this problem, on the average, regressed in their thinking from pre-test to post-test after interacting with a partner who had used a lower-level rule on the pre-test.

What can be concluded from this research? If the task is collaborative seatwork and if high-achieving students have the chance to give explanations, then heterogeneous groups will be

especially beneficial for them. If the group is composed of only medium-achieving combined with low-achieving students, one would expect that the medium-achieving students would have the benefit of giving explanations. This proposition is predicated on the idea that the process of providing explanations is helpful for any student, but the "better" the students in the group are more likely to engage in such behavior. If the task is very challenging and ambiguous, and has an ill-structured solution, if a heterogeneous pair is left alone to converge on an answer, then the confidence of the more developmentally advanced child can be shaken and he or she may regress to a view of the matter that he or she held at a younger age. The only result that seems to hold unconditionally is the benefit to the low-achiever of being in a heterogeneous group as compared to a homogeneously low-achieving group.

Interdependence and Interaction

Designers of cooperative learning tasks must contend with one consequence of using small groups. One may give a group a task, but unless there is some reason for the group to interact, students may well tackle the task as individual work. This is especially the case if each individual must turn out some kind of worksheet or report. This is also the case if the instructor divides the labor so that each person in the group does a different part of the task; and the group has only to draw these pieces together in sequential fashion as a final product. The consequence of either of these patterns is that there is comparatively little interaction; and people do not gain the benefits of using each other as resources, nor is there any basis for expecting the pro-social outcomes of cooperation.

In the literature on cooperative learning, this problem is most typically addressed as one of the necessity for interdependence of the members of the group (Johnson, & Johnson, 1990).

In order to insure interdependence through limiting resources or through setting a group goal, it is typically recommended that there be only one worksheet or report for the group. The object is to insure that a group will be created because members are dependent on one another to achieve the group goal (positive goal interdependence) and will need to use each other's resources to attain that goal (resource interdependence).

Positive goal interdependence is a concept taken from Deutsch(1962) meaning that individuals perceive that they can achieve their goal if and only if the other individuals with whom they are cooperatively linked also achieve their goals (Johnson, Johnson, & Stanne,1990). Positive resource interdependence exists when individuals can only achieve their goals when other group members provide needed resources. The Johnson model of cooperative learning advocates the use of both goal interdependence and resource interdependence. In a cognitively demanding computer simulation in which high school students had to apply both navigational and map reading skills to sail ships to the New World, conditions with both positive goal interdependence and resource interdependence led to better performance on the simulation than conditions with only one of these two types of interdependence(Johnson, Johnson, & Stanne, 1990).

However, interdependence of either type does not necessarily solve the problem of guaranteeing interaction. When there is a strong division of labor, but the group is committed to turn out a single end product, one may say the group is interdependent, but there is still no strong motivation for the group to interact and solve problems as a group. The limitation of goal interdependence is illustrated by the computer simulation study just cited; goal interdependence alone did not promote more effective performance. One may speculate that although the three

group members were given the same goal of getting all three ships to the New World, if they divided the labor and each attempted to sail one ship, then there might have been minimal interaction possibly reducing understanding and problem-solving success. Simple resource interdependence has similar problems with respect to interaction. When group members are simply dependent on one another for resources (sharing information in the case of the navigation task) but do not share a goal, achievement is also impaired because interaction consists of one person trying to get information from another but perhaps wanting to avoid wasting time by giving information. Simple resource interdependence, in this study, was associated with the poorest results(Johnson, Johnson, & Stanne, 1990).

Simple resource interdependence is also present in the "jigsaw" procedure(Aaronson, Blaney, Sikes, & Snapp, 1978) where members are oriented to their individual performance, but obtain information from peers who become "expert" on their topic after work in specialized groups. There were no achievement differences in this study between jigsaw and traditional instruction even though the tasks were of the routine, social studies variety. Huber and Epler (1990) note that slow-learning members of jigsaw teams do not necessarily return from their expert group sessions knowing more than their team members. There is, in this case, no particular motivation to interact with and to help these team members to learn.

We propose a reformulation of this problem, not so much in terms of interdependence, but in terms of the type of interaction fostered by these differing task instructions. A proposition for future research is as follows:

> Effects of resource and goal interdependence on productivity will be mediated by the amount and type of interaction stimulated by these task arrangements.

Resource interdependence alone will be associated with lower participation rates on the part of those students who stand most to gain by receiving assistance than will resource and goal interdependence combined.

Resource and goal interdependence taken one at a time, are not sufficient conditions for activating group participation.

The organizational concepts of sequential and reciprocal interdependence introduced earlier in this review pertain more directly to the type of interaction that takes place in the group and thus will have considerable heuristic value for research on productive small groups.

Reward Interdependence. One task condition that has the power to stimulate students to participate and to help each other is the presence of rewards to the group based on the performance of each individual member. This is sometimes referred to as "reward interdependence."

No aspect of cooperative learning has been as controversial as the issue of giving rewards to groups on a competitive basis. This issue has become enmeshed in the ideological controversy over cooperation vs. competition as has the issue of extrinsic vs. intrinsic rewards for students and their relationship to learning. The best known research and reviews of research on this topic have been those of Robert Slavin(1983a;1983b; 1987). After reviewing 41 studies of cooperative learning that contrasted cooperative treatments of various types with traditional, individualistic learning, he came to the following conclusion: achievement is enhanced by cooperative learning when cooperating pupils are rewarded as a group, while each pupil is individually accountable for his or her learning(1983a). In the most widely disseminated of the various models of cooperative learning developed by Slavin and his colleagues, a technique referred to as the STAD

procedures, individuals take a test on their own learning and receive individual grades. For the purpose of public recognition, a group score or team score is awarded that is a composite of how well each individual has done relative to his or her own past performance. Certificates of award are handed to the team with the highest score, or the winning score is published in the class newspaper, or posted on a bulletin board. Slavin's conceptualization of how cooperation leads to achievement emphasizes individual accountability as strongly as group rewards. He states, " learning is enhanced by provision of group rewards if and only if group members are individually accountable to the group for their own learning. Individual accountability can be created either by providing specific group rewards based on members' learning, or by having students perform unique tasks and providing incentives for students to learn from each other" (Slavin, 1983b, P. 59).

Because all the comparisons that Slavin uses are experiments contrasting one of the cooperative learning techniques to whole class or individual instruction, his generalization is based on how consistently cooperative learning conditions of various types bring superior results to a non-cooperative situation. His strong generalization, however, implies a contrast between differing approaches to cooperative learning that systematically vary individual accountability and the presence or absence of group rewards. Bossert also makes this point in his review of the literature: "Slavin has not clearly tested the value of group contingencies within the Student Team Learning methods"(Bossert, 1988, p. 233). Vedder(1985) was highly critical of Slavin's review for the same reason as well as for counting as positive, studies where only the minority students made significant gains in achievement. He sharply disagrees with Slavin's characterization of some of the studies as having positive outcomes.

Okebukola(1985) directly contrasted Teams Games Tournaments, STAD procedures, jigsaw, and the Learning Together model(based on the Johnsons' approach to cooperative learning). From a theoretical point of view, both Teams Games Tournaments and STAD procedures employ competitive, extrinsic reward interdependence as well as individual accountability. The jigsaw technique, as explained above, does not have an explicit group goal or reward, but students are dependent on one another for information. The Learning Together model (circa early 1980's) features both goal and resource interdependence, but did not employ competitive, extrinsic reward interdependence nor did it allocate scores to individuals. Theoretically, it did not have a strong feature of individual accountability. On a test of science achievement employing both lower and higher level cognitive items, although all the cooperative methods were superior to independent study or to traditional whole class instruction, the Learning Together model produced the least favorable achievement results of the cooperative methods and the STAD procedures produced the most favorable results. The Johnsons(1990) also describe several studies in which they have been involved in which the use of reward contingencies in connection with goal interdependence provided more favorable achievement results than goal interdependence alone.

The effectiveness of reward interdependence, however, should not be taken to mean that it is not possible to hold individuals accountable or to motivate them to participate without such reward contingencies. Such rewards are not used in either Group Investigation that compared favorably to STAD in producing achievement on items measuring higher-order thinking (Sharan et al., 1984) nor are they used in complex instruction where the activities are intrinsically interesting. Complex instruction has also been found to produce significant achievement

gains(Cohen, 1990). Slavin's original proposition about the necessity of reward interdependence and individual accountability would appear to apply better to the kinds of collective or collaborative seatwork tasks that are so common in cooperative learning where it is of vital importance to motivate those who could do the task by themselves to interact and to assist those who are having difficulty. These are not group tasks as defined in earlier in this paper, because they could be carried out by one individual. Reward interdependence does not appear to be necessary for achievement when students are motivated to complete a challenging and interesting group task that requires everyone's contribution for a good outcome. This proposition appears to hold at least when individual accountability is maintained by other strategies such as requiring individual reports or making individuals responsible for some portion of the end product.

Offering rewards on a competitive basis, although effective in increasing motivation of team members to work together, may have negative effects on intergroup relations, more specifically on the perceptions that team members have toward other teams. Miller, Brewer, and Edwards(1985) report an experimental study in which the reward structure varied: in the cooperative condition, subjects were told that the problem solutions of the two teams would be evaluated jointly to determine their joint eligibility for a small monetary reward; in the competitive condition they were told that the team with the better product would be eligible for a reward. After an initial phase of work as separate teams, the teams convened to discuss and to arrive at a final consensus. In the cooperative condition on a post-experimental measure, team members were more willing to allocate rewards to individuals on the other team and held more favorable perception of members of the other team than in the competitive condition. Similarly, a meta-analysis of studies of heterogeneous classrooms contrasting cooperation with and without

intergroup competition showed that perceived personal attractiveness of non-team members was lower with intergroup competition(Johnson, Johnson, & Maruyama, 1984).

In addition to this issue of the effect of competition on perceptions of out-group members, there is some evidence that methods using competition such as Teams Game Tournaments and STAD procedures are ineffective for particular categories of students. In Teams Games Tournaments(TGT) which is personally competitive, Mexican-Americans were found to do less well in the learning of spelling in comparison to other methods of cooperative learning, while Anglo Americans did best in this method (Kagan et al., 1985). In a racially and ethnically diverse classroom, the negative effects of between-group competition may well offset the advantages of within-group cooperation in improving intergroup relations and in improving achievement of some ethnic groups. A study of TGT in the learning of mathematics has also shown that the failure of one's team can have a negative effect on one's individual achievement in a way that is independent of prior achievement and individual outcome(Chambers and Abrami, 1991). Moreover, the effect of participating in an unsuccessful team using STAD procedures was negative on mathematics achievement for those students characterized as "learned helpless" and had no effect on those students characterized as "mastery-oriented(Abrami et al., 1992).

Part II -- Factors Affecting Interaction

Structuring the Interaction: Task Instructions

There are a number of ways in which the designers of groupwork tasks attempt to insure interaction from the participants. These range all the way from simple task instructions in which students are told to help each other or to discuss and come to consensus, to detailed procedures concerning how and what is to be discussed. In some cases, the interaction may even be scripted

with specific conversational strategies that students practice before attempting the group task e.g. Spurlin et al., 1984. In an attempt to raise the level of discourse and to ensure its effectiveness, some investigators and developers have instructed groups in specific ways that they should talk with each other. Assigning students particular roles is another way to get group members to take responsibility for active participation in the group. However, roles do not have a consistent effect on group interaction. If the labor is divided and each person is given a different role such as artist, script writer, presenter etc., the result may be each person quietly working on his or her task; there will be very little interaction at the group level. In contrast, a role such as group facilitator may have the effect of fostering interaction.

The problem as posed by some researchers(Yager, 1985; Brown and Palinscar, 1986) is whether it is effective to structure the interaction within small groups. Certainly, those investigators moving from a position of social constructivism would be opposed to such interference with the process of negotiation of meaning. From the perspective of this reviewer, the most useful research question to ask is not whether structuring interaction is productive, but under what conditions it is productive. What conditions constrain the interaction or hinder full exchange from all participants in the group? Whether or not procedures that constrain and direct interaction are effective has to do with the kind of interaction that is necessary for optimal outcomes, given the nature of the learning outcomes that are desired.

Constraining the Interaction. Let us start with two studies of the effects of structured oral discussion on tests of achievement and retention of map skills in social studies. Yager(1985) studied the effects of structured oral discussion on seventh and eighth grade students working on a map unit involving assignment sheets and desk-size world maps. Heterogeneous groups met 45

minutes per day for 25 days. Following 15 minutes of teacher instruction, students in the structured condition were randomly assigned the role of learning leader or learning listener. The responsibility of the leader was to restate and summarize the main points of the day's lesson while the learning listener was to ask probing questions, encourage the leader to explain better, recall areas of content left out and discuss ideas or facts summarized incorrectly. This condition was contrasted with unstructured groups which were simply told to discuss the material after the teacher's initial instruction. The structured conditions did significantly better on the unit test and on a later test of retention. Similar results for this type of structured oral discussion were achieved with second graders working on a map unit where the instructional objectives were measured by factual recall(Yager, Johnson, and Johnson, 1985).

Structured oral discussion has some similarity to reciprocal teaching of Brown and Palinscar(1986). This technique also structures the interaction, not with roles but with specific strategies of questioning, clarifying, summarizing and predicting. These strategies are designed to improve comprehension of reading and to serve as a self-testing mechanism. Reciprocal teaching has been shown to be effective on retention and comprehension of reading. However, with one exception, the research on reciprocal teaching does not fit the definition of cooperative learning used in this review because the teacher directly supervises the students who play the role of teacher. In one exploratory study(Palinscar, Brown, and Martin 1987), students were allowed to play the role of teacher after ten days of reciprocal teaching instruction, working with groups that operated independently of the classroom teacher. The gains indicated by the tutees in these groups on the comprehension assessments were comparable to those made by students working with their adult teachers in former studies.

The general inference that can be drawn from this research is that when the learning task is factual recall, understanding of the assigned reading, or application of procedures and concepts in a relatively routine fashion, structuring the interaction through roles and scripts can be very effective. Such strategies probably owe their effectiveness to their capacity to raise the level of discourse and to ensure that disengaged students are drawn into participation.

Limited Exchange Processes. Interaction can also be constrained by telling the groups that their principal task is to complete individual worksheets, but they are urged to consult with one another and to help one another. These are the task instructions used in the studies reviewed by Webb; Slavin's STAD procedures also use these instructions. In the STAD procedures there is an additional reward feature discussed above. Important for this discussion are two features: (1) these instructions are typically given in connection with tasks that have well-structured solutions; and (2) there are only a certain number of types of interaction that need take place in this context. Students can exchange information, explanations, or they can request assistance. They have no need to discuss how to proceed as a group, nor do they have to discover anything as a group or to negotiate any meanings. There is very little room for extensive controversy except for arguments over what is the right answer or procedure. It should be noted that this kind of limited cooperative interaction is typically used for conventional school tasks such as computational mathematics assignments, or understanding and being able to recall reading assignments.

In an extensive field experiment, Slavin's STAD techniques were compared to Sharan's Group Investigation method with respect to effects on learning outcomes as well as on the development of pro-social, cooperative behaviors(Sharan et al. 1984). Group Investigation fosters

far more extensive kinds of interaction than the STAD method. Groups are given the task of developing extensive presentations for the class. They must work together in planning this presentation and must develop procedures for dividing the labor on the component research tasks. After collecting the information, they must coordinate individual contributions into a unified group product. The experiment took place in a desegregated junior high school in Israel; classes were English as a Second Language and Literature; and they were untracked. Sharan et al. characterize important differences between the two techniques: with STAD, the teacher transmits the information or a text transmits the information. The teacher emphasizes information and/or skill acquisition. In Group Investigation, the information is gathered by the pupils using a great variety of learning sources. The tasks stress problem-solving interpretation, synthesis and application of information. In STAD, peer communication is primarily for rehearsal of teacher-taught materials. Pupils interact sporadically or in dyads as contrasted with group interaction necessary for the Group Investigation techniques where interactions are based on mutual exchange.

The results on the literature tests were instructive. On high-level questions, the Group Investigation classes did significantly better than the STAD classes. On the low-level questions, STAD classes performed significantly better than the Group Investigation classes. On the tests of English, both these cooperative methods were more effective than traditional instruction, but they were not different from each other with the exception of the listening comprehension scale where the Group Investigation classes were superior. This study illustrates how differences in the type of interaction fostered by the task and task instructions are associated with different learning outcomes. For relatively low-level outcomes, the limited interaction model with its focus on

acquiring information and correct answers is adequate and often superior. For higher-order thinking skills, the interaction must be more elaborated and less constrained.

What about the STAD procedure is less effective for higher-order thinking objectives? When Ross used STAD procedures for developing higher-order thinking skills in two experiments(1988), he found that the cooperative groups using STAD procedures did no better than students working independently on practice worksheets following 20 minutes of teacher-directed dialogue. In the cooperative condition, students worked on the same worksheets as were used in the whole-class treatment. Each student was to complete his or her worksheet after conferring extensively with peers. Ross' worksheets take abstract problem-solving such as learning how to represent problems effectively and translate these skills into step-by-step problem-solving through algorithms. The use of these worksheets was clearly more effective than a third treatment where problem-solving was embedded in the content knowledge, but there were no worksheets and no explicit direction or encouragement for developing problem-solving skills. However, these experiments do not tell us how well students would have done with these materials if an exchange that was less constrained by worksheets were fostered between the students.

Inadvertently, we learn something about this alternative from a teacher who failed to follow detailed procedures for having students discuss the worksheets(Ross and Raphael,1990). In this study, the interaction was supposed to be even more controlled than in Ross' previous studies of cooperative learning. Students were to read worksheets and work on the task individually, share answers, compare their answers to those on the feedback sheets and then to discuss discrepancies between student answers and the exemplary answer on the feedback sheet.

The objective here was to develop the ability to make comparisons. One of the two teachers followed the procedure precisely while the other allowed students to work out their own procedure. The latter teacher obtained much better results. More important than this result was the finding that there was much more interaction in her groups. Students made more factual and conceptual contributions in those unstructured groups with higher rates of interaction. Achievement outcomes were more favorable for groups where students more frequently contributed facts and concepts. These unintended results suggest that too much structure of a task that involves higher-order thinking skills is dysfunctional because it impedes conceptually-oriented interaction. As with scripting and roles that limit the nature of the interaction, the limited exchange processes(in conjunction with the reward features of the STAD procedures) are effective for acquiring information and other conventional school tasks. It should be noted that this effectiveness occurs in conjunction with teacher and textual presentation of information.

Hertz-Lazarowitz(1989) makes the distinction between low-cooperation group tasks where students simply share materials or information or divide the labor so that each person's contribution can be joined together as a final product, to high-cooperation tasks where students must interact as they work together, discuss planning, decision-making, and division of labor as well as substantive content. In a study of interaction among 782 students, grades 3-8, in Israel, she found that of cooperative tasks, only 31% could be classified as high-cooperative. Most relevant to this discussion is the finding that whereas 56% of the interaction in low-cooperative tasks was about information, in high-cooperation tasks, 70% of the interaction had to do with application. These findings suggest that more conceptual interaction takes place in high-cooperation tasks.

Nystrand, Gamoran, and Heck(1991) make a similar distinction between groupwork tasks which are only collaborative seatwork and tasks that permit the students to define their problem and to engage in autonomous production of knowledge. On a test of understanding of literature that included conceptual questions, they found that ninth grade classes spending more time in cooperative groups that demanded production of knowledge scored significantly higher on the test than classes spending less time in such groups. If the researchers did not divide the small group work in this way, the overall use of small groups had a negative relationship with scores on the test.

If, as we argued above, interaction is critical for achievement gains for group tasks with ill-structured solutions, then factors that affect the amount and richness of interaction will affect productivity for such tasks. Tasks with higher-order thinking skills as their objectives are typically, but not necessarily(See Ross, 1988), seen by developers as open-ended tasks with ill-structured solutions. The general proposition we would like to examine is the following:

> As the teaching objective increases in cognitive complexity, task arrangements and instructions that constrain and routinize interaction will be less productive than arrangements and instructions that foster more conceptual and elaborated discussions.

Salomon and Globerson (1983) make a similar point: "But such highly structured procedures as found in scripted cooperation, reciprocal teaching, or group attempts to gain rewards may not be the most desirable arrangements for when teams have to engage in more complex, free exploratory activities on a prolonged basis(p. 96).

Hertz-Lazarowitz(1989) as well as Nystrand, Gamoran and Heck(1991) imply that unless groups determine their own procedures, their interaction will be less "elaborated." However, there

are studies of cooperative learning with rather elaborate procedures spelled out for the students that do not result in a limited or concrete type of interaction. On the contrary, the literature suggests that the way the instructions set up the problem, suggest procedures, and specify roles can do much to create interaction that is markedly superior to that produced by simply asking a group to reach consensus.

The research on the benefits of controversy within cooperative learning(Smith, Johnson, & Johnson, 1981; Johnson & Johnson, 1985) is the best example of how elaborate procedures and use of student roles can foster high-level discussion leading to conceptual understanding. In these two studies, students in the controversy condition worked in four-person groups over several classroom sessions. First, two-person pairs, having been provided with relevant information, prepared opposing sides of a debate concerning conservation vs. economic interests on the interesting topic of the proposed reintroduction of wolves into Minnesota. Within the pairs each student played a relevant role such as farmer or rancher. Following this preparation, the pairs presented their opposing sides. The opposite pair was motivated to listen very carefully because the next phase required the pairs to switch sides and argue, using the information that had been presented. Finally, the entire group had to arrive at a consensual view of the issue and to write a group report.

In the first study (Smith, Johnson, & Johnson, 1981), the controversy condition was compared to a concurrence condition where each small group could study the material in any way they wished, with the stipulation that they were to avoid arguing. The controversy condition not only promoted higher achievement on a test and better retention on a second test than the concurrence-seeking condition, but more pertinent to this discussion, there was a greater search

for information and more cognitive rehearsal. On the achievement test, students were asked to take multiple perspectives in a way that tested their grasp of the concepts. Students who had experienced the controversy condition, not surprisingly, were better able to take multiple perspectives. In the second study, the controversy condition was compared to a jigsaw debate in which students representing each role and position prepared their case in a first phase. In the next phase the four-person groups were reassembled and carried out a formal debate. The students were told that they were responsible for learning about all these positions. The controversy condition promoted the most verbal rehearsal and exchange of assigned materials, the most active search for more information, and the most reevaluation of one's own position.

Note the elaborate way in which the discussion was controlled in the controversy condition by the discipline of having to take sides and by having to play roles. Despite the elaborate structuring of interaction, the quality of the discussion in the controversy condition was superior to that in the concurrence or the debate conditions. The comparison with the debate condition illustrates that the power of this technique to foster higher-level discussion does not lie solely in having to take sides. The instructions to the controversy groups fostered a reciprocal exchange in which the outputs of each actor became inputs of each other actor. Having examined the issue carefully from all sides, the group was well-prepared for an in-depth discussion when they tried to come to consensus.

Roles. When the group is working on problems with ill-structured solutions, roles can also be used to foster interaction that leads to conceptual gains. Working with classrooms using complex instruction, Zack(1988) showed that the use of a facilitator role was associated with an increase in talking and working together on discovery problems using math and science concepts.

Talking and working together, in this setting, predicted gains in tests of mathematics concepts and applications(Cohen, Lotan, & Leechor, 1989). Using the same approach of complex instruction, Ehrlich(1991) studied a special adaptation of the commonly used role of the reporter. The reporter was given a special worksheet and time to discuss with the group the answers to a set of questions in preparation for his or her report to the class as a whole. The enhanced reporter's job was to encourage the group to think and talk together, and as a group, to come up with answers to the questions on the special form. These questions were timed at the beginning of the task, in the middle and at the end. They were designed to encourage science-thinking behaviors. For example, the group was asked to specify their predictions for the science experiment, their observations, the inferences from their observations, and the extent to which their predictions were supported by their observations. Fourth-grade classes receiving this treatment were compared with classes using the same curriculum and techniques for cooperative learning, but the reporters were allowed to prepare their report for the class pretty much as they saw fit. Classroom observations revealed that there was a greater incidence of student interaction with one another when they used the reporter form than when groups were not using the form. On a criterion problem-solving task at the end of the year, groups from classes that had experienced the enhanced reporter form demonstrated more science-thinking behaviors. These behaviors included asking thinking questions, requesting justification, predicting, hypothesizing, inferring and concluding(Ehrlich, 1991).

Here was the use of a role and a specific set of topics for the groups to discuss that fostered an abstract level of interaction, encouraging the children to use the language of science in a way that was distinctly new for all of them. Yet this interaction was not scripted or

micromanaged. The children were free to search for the answers to these questions in ways they found productive. The distinction is a subtle one; task instructions can profitably set problems for discussion, specify roles, ask questions, determine procedures, all without constraining the full discussion of a problem with an ill-structured solution. However, this review would suggest that moving beyond these strategies for structuring the interaction to introduce worksheets that specify steps to solutions, to introduce strategies for talking about the content or to constrain the discussion by having one student play the role of the teacher and the other the learner would be counter-productive for solving problems with ill-structured solutions designed to foster the development of higher-order thinking.

There are some clear implications for practice from this discussion. Teachers must first decide whether their objectives include the development of higher-order thinking skills. If they do not, then techniques such as the STAD procedures or structuring the interaction in detail with scripting or reciprocal teaching may be highly effective. If the task is open-ended and is designed to develop higher-order thinking skills, then the teacher must find a way to foster the desired level of interaction. Herein lies the dilemma: if teachers do nothing to structure the level of interaction, they may well find that students stick to a most concrete mode of interaction. If they do too much to structure the interaction, they may prevent the students from thinking for themselves and thus gaining the benefits of the interaction.

Insuring Equity in Interaction

There are systematic inequalities in participation among members of cooperative groups. Moreover, these inequalities are related to academic status differences between students; low-status students interact less frequently and have less influence than high-status students (Hoffman,

1973;Tammivaara, 1982; Rosenholtz, 1985). Status is here defined as an agreed-upon rank order where it is generally felt to be better to be high than low rank. In the studies cited, despite the fact that the tasks demanded no academic skills, those students who were perceived to be better readers or better at schoolwork were more active and influential than those students perceived to have less academic ability.

Several studies have further helped to rule out the possibility that some kind of actual ability difference is the source of this difference in rates of participation. In an analysis of interaction in cooperative learning groups of junior high school students of mathematics, Webb and Kenderski(1984) found that test scores did not predict the frequency of giving explanations. Rather, test scores relative to other members of the group predicted how frequently members gave explanations. The effect of measures of relative ability rather than absolute ability suggests that the determinant of interaction was the difference in perceived ability in mathematics within the small groups. Dembo and McAuliffe(1987) created an artificial distinction of average and above average ability with a bogus test of problem-solving ability, described as relevant to an upcoming experimental task. Higher-status students(defined as those publicly assigned above-average scores on the bogus test) dominated group interaction on the experimental task, were more influential, and were more likely to be perceived as leaders than low-status students.

Differences in perceived academic ability are not the only sources of inequality within cooperative groups. Differences in perceived attractiveness or popularity, i.e., peer status, can also act as the basis for status differentiation(Webster and Driskell, 1983). Popularity is often highly correlated with academic status, as in the classrooms studied by Rosenholtz and Wilson(1980).

Differences in social status such as gender, race and ethnicity can also affect interaction

of schoolchildren (Cohen, 1982). However, these effects have primarily been demonstrated in laboratory studies where students do not know each other. In classrooms, race and ethnicity often correlate with academic status; and as a result, it has not been possible to document these effects separately in groups composed of students in a single classroom (Cohen, 1982). McAuliffe(1991), working with hypothetical cooperative learning groups on a questionnaire, also found that being a good student was far more powerful than race or gender in predicting approval for leadership behavior. Leadership behavior from those described as poor students was likely to be disapproved. Only when academic status is uncontrolled, can one see the effects of ethnicity in classroom studies. In a study of Middle Eastern and Western Jews in classrooms in Israel, Sharan and Shachar(1988) gave mixed-ethnic groups a discussion task and observed that Western Jews took significantly more turns at speaking than the Middle Eastern Jews and used significantly more words per turn.

Webb(1984b) found some strong evidence of the effects of gender in classroom groups of seventh and eighth graders studying mathematics. In majority-female groups, females directed most of their interaction to males and showed lower achievement than males. In majority-male groups, males tended to ignore females and showed somewhat higher achievement than did females. These differences were not observable in groups with equal numbers of males and females. Although girls are less active and influential than boys in cooperative groups of adolescents, gender does not appear to operate as a status characteristic in the early elementary years(Lockheed, Harris,& Nemceff, 1983; Leal, 1985).

Status problems make small group discourse non-productive according to at least two of the definitions of productivity: inequitable interaction as well as unequal learning outcomes.

Inequities in participation based on gender, race and ethnicity within cooperative groups should be a source of serious concern for those who recommend cooperative learning for heterogeneous settings. If the participants in cooperative learning have pre-existing stereotypes about lesser competence of minorities and women confirmed in their group experience, then the effects of cooperation are far less desirable than many proponents of the technique would have us believe.

These inequalities in participation are worrisome for another reason: they are linked to learning gains. Cohen(1984) demonstrated that the status of a student was correlated with interaction within the small group. Interaction, in turn, was a predictor of learning gains. This review has already cited research showing those conditions under which interaction is related to achievement gains. Clearly, the operation of these status effects is particularly detrimental to small group productivity where interaction is critical for learning.

Status Characteristic Theory(Berger, Cohen, & Zelditch, Jr., 1966; Berger, Cohen, and Zelditch, Jr., 1972) provides an explanation for these effects of status as well as a basis for several interventions designed to equalize status within the groups. Status characteristics, a central concept of this theory, are defined as socially evaluated attributes of individuals for which it is generally believed that it is better to be in the high state than the low state.

Status generalization is the process by which status characteristics come to affect interaction and influence so that the prestige and power order of the group reflects the initial differences in status. When a status characteristic is specific(such as reading ability), knowledge of the characteristic provides specific performance expectations for individuals who are in the high and low states of the characteristic.

Academic status characteristics are the most powerful of the status characteristics in the

classroom because of their obvious relevance to classroom activities. When the educator gives a group a collective cooperative task, status differences based on academic ability become activated and relevant to the new situation, even if the task does not require the academic ability in question. The high-status student will then expect to be more competent and will be expected to be more competent by others. The net effect is a self-fulfilling prophecy whereby those students who are seen as having more ability become more active and influential than those students who are seen as having less ability. When status generalization takes place, not only are low-status students cut off from access to the resources of the group, but the group lacks the contributions and ideas of all its members. The process by which specific status characteristics generalize to new collective tasks is the same as that by which diffuse status characteristics such as race, ethnicity and gender affect interaction.

The Multiple Ability treatment is an intervention in which teachers convince students that many different abilities are relevant to the group task(for example, reasoning, creativity, and spatial problem solving). Moreover, if the teachers are successful in using the multiple ability treatment, students believe that each member of the group will be good at some of these abilities, and that no member of the group will be good at all these abilities. In Tammivaara's laboratory study(1982) and in S.J. Rosenholtz's classroom experiment (1985) a multiple ability treatment substantially weakened status effects. In nonexperimental classroom conditions, Cohen, Lotan and Catanzarite(1988) showed that the effects of status on interaction were reduced by a multiple ability treatment, though not eliminated. In a classroom setting, a successful multiple ability treatment requires the use of a multiple ability curriculum. If the assignments to groups are restricted to conventional academic skills, then it is unlikely that students or teachers would

believe that every student would have at least one of the requisite intellectual abilities or that no student would have all the abilities required.

Assigning Competence to Low-Status Students is a second intervention designed to insure equity within cooperative groups. This treatment requires the teacher to observe students within groups as they work on multiple ability tasks. When a low-status student demonstrates competence on an important intellectual ability(such as spatial reasoning, or scientific thinking) she publicly provides an evaluation for that student describing specifically what he or she has done well, what ability he or she is displaying, and why this is an important resource for the group. Teachers who use these two status treatments more frequently have more equal-status interaction within their cooperative learning groups(Cohen, 1988).

Several propositions emerge from this review on equity within cooperative groups. In order to maximize productivity of cooperative learning, it is necessary to modify the effects of status. When the task is of a more routine variety, good effects can be achieved with scripted interaction and turn-taking, both of which will cut down on the possibilities for status to affect interaction. When the task is an ill-structured problem, however, it is necessary to treat differential expectations for competence in order to achieve maximum interaction and productivity.

When cooperative learning is used to improve intergroup relations, the concerns are not only that there be equal-status interaction, but also that students of different groups learn to treat each other as persons rather than as members of social categories. On the basis of experimental work, Miller, Brewer and Edwards(1985) caution teachers to avoid making the explicit use of racial or ethnic identity as a basis for team formation. For the same reason, they advise against

a mechanical composition of groups in which the percentage of each social category is always the same. For example, if a class were 30% black, the teacher might make a third of each group black. In a laboratory analogue of this situation, these experimentalists created new social categories based on the results of a pre-test in which subjects were randomly assigned to two groups called "dot overestimators" and "dot underestimators". When assignment to groups was explicitly based on these categories, with one outgroup member and two ingroup members, those in the minority status showed more bias toward the other group than when assignment to groups was non-categorical. These findings on salience of social categories should also apply to gender; teachers should avoid composing groups so that they always have half males and females.

Classroom Factors Affecting Interaction

In addition to the design of the groupwork task itself, a number of classroom strategies will affect the interaction and productivity of the small groups. Considerable attention is paid to these factors in many thorough staff development programs in cooperative learning.

Training Students for Cooperation. Many developers of cooperative learning models have observed that groups quite frequently fail to show behaviors that one might call cooperative; in fact, close examination of some groups reveals negative and insensitive behavior as well as refusal to assist one another in any meaningful way. The behavior called for in cooperative small groups is radically different from the behavior required in conventional classroom settings. Therefore, some developers of cooperative learning strongly recommend team-building or skill-building activities that take place prior to cooperative learning that are designed to develop the pro-social behaviors necessary for cooperation as well as some specific skills for working successfully with others. Or, adapting techniques from group dynamics, they suggest that groups

become aware of their interpersonal and work processes as they work, and take time to discuss how they are doing as a group.

Available research on the effectiveness of such strategies suggests that investing in such preparation and time spent on group process can definitely make for more productive groups. For example, Swing and Peterson(1982) experimented with training fifth-graders in task-related interaction and more specifically in improving explaining skills. The preparation included a practicum in explaining in which each student had the chance to explain a problem and to receive feedback from training personnel. The trained groups were compared on a test of mathematics achievement to control groups who participated in identical collaborative seatwork tasks, but received no training in interaction. The trained groups had significantly higher rates of task-related interaction and provided and received more higher-order explanations than the control groups. Although there were no statistically significant differences in achievement and retention between the two conditions, those students with low scores on the pre-test, who were trained, outperformed on the retention test control students with similar scores on the pre-test . It was also the case that those low-achieving students who more often provided and/or received conceptual explanations during seatwork obtained higher achievement scores.

Similarly, in collaborative seatwork on vocabulary words, Lew, et al.(1986) trained students in collaborative skills of sharing ideas and information, keeping the group on task, praising and encouraging the contributions of others, and checking to make sure everyone in the group understood what was being taught. Moreover, the teacher awarded bonus points toward the quiz grade if all group members were observed to demonstrate three out of four cooperative skills. The addition of training in cooperative skills, plus the reward contingency for cooperative

behavior was necessary before cooperative groups produced superior achievement results to individual study. Positive goal interdependence and academic reward contingencies were not enough by themselves to produce superior achievement results.

Giving students specific feedback on their cooperative behaviors and having a chance to reflect on how the group is behaving with respect to specific skills can have good results as well. A combination of these two strategies of teacher feedback and group processing proved more effective on a complex computer simulation problem than either the large-group processing alone or the condition where no processing took place(Johnson, Johnson, & Stanne, 1990; Johnson et al.,1990). The Group Investigation method also provides extensive feedback on cooperative behavior, a feature that is not present in the STAD procedures to which it has been compared(Sharan et al., 1984). In an evaluation of the effects of Group Investigation and STAD, students from both conditions were asked to copy a Leggo figure from a model. The students from the Group Investigation classrooms showed more cooperative behavior and less competitive behavior than the students from STAD classrooms(although either of these two cooperative methods produced more cooperative behavior and less competitive behavior than the classes that had received traditional whole-class instruction.)

All these studies utilized very specific behaviors whether in pre-training or in feedback and group processing. The importance of specificity is illustrated by the failure of a procedure utilized by Huber and Eppler(1990). Half the groups of fifth graders who participated in jigsaw learning with group reward contingencies rated their own cooperative process by means of a six point scale. They rated polarities such as friendly-hostile, hardworking-careless. Students were provided with the three most positive and three most negative ratings of their own group

members on graph paper. They were then asked to discuss for five minutes what went wrong during the last session and how they could improve cooperation next time. The process feedback had no effect on achievement.

The behaviors must not only be specific but they should be directly relevant to the desired behaviors in the particular tasks that the teacher has assigned to the groups. In working with cultural diversity in the classroom, Miller and Harrington(1990) recommend a direct linking of group process skills to the team's task goals as opposed to human relations training programs that emphasize the general development of sensitivity, receptivity, openness and reciprocity. Their rationale is that the former approach promotes more personalized interaction that helps people treat each other as persons rather than as members of categories. For example, Johnson et al.(1990) selected for processing the behaviors of summarizing ideas and information of all group members; encouraging active oral participation of all members, and checking for agreement among members each time a decision was made as relevant to a group working on a computer simulation. During the student-led processing, each member was assigned responsibility for ensuring that all members engaged in one of the three social skills.

When there is no preparation for cooperative interaction, mixed gender groups have been shown to work quite differently from single gender groups and can present problems of unwanted male dominance. Mixed-gender pairs working on a LOGO programming exercise exhibited social dominance by the boys; girls were less motivated and successful(Siann & Macleod, 1986). Underwood and McCaffrey(1990) studied pairs of students (10 and 11 years of age) on a computer task filling in missing letters from words. They were not told how to work together. Single-sex pairs were more productive than mixed-sex pairs. Unlike the single-sex pairs, there

was no improvement for mixed-sex pairs in their group performance over their individual performance. Single-sex pairs worked by discussion and agreement with each member of the pair contributing. Keyboard control was shared. In contrast, the mixed-gender pairs tended not to work by negotiation, but simply divided the labor with one taking over the keyboard and the other instructing the typist with little discussion of alternative solutions.

Here is another example of the dangers of failing to think through the kind of interaction that is desirable for the teaching objective. In computer tasks, the students left to their own devices may well choose a division of labor of "thinkist" and "typist" in which there is relatively little interaction and argument. This is evidently especially likely to happen with young boys and girls who have often been observed to have strained and uneasy relationships with one another in the early elementary years. Students require preparation and instruction for the level of interaction that is considered desirable for the task. If this preparation had been undertaken, it is unlikely that mixed-gender groups would represent a special problem although this is an empirical question for future research.

In sum, either pre-training or processing of the group while they are at work on the task can be effective in improving the productivity of small groups. There are several ways in which these procedures probably operate to improve the functioning of the group. They reduce interpersonal conflict; they increase the probability of specific behaviors that have been linked to learning outcomes; and they help the members of the group to take responsibility for each other and for what is happening in the group. Thus they help to solve the key problem of motivation to participate. However, it is unlikely that these procedures will be effective unless they are both specific and relevant to behaviors that lead to the group goal. One note of caution:

if the group is given an ill-structured problem, the procedures should not be so specific to what the group is supposed to say and think that they succeed in micromanaging the thinking and talking process.

Teacher Role. Obviously, when students are working independently in small groups, the teacher's role changes. She or he cannot be everywhere at once telling people what to do; whenever the teacher tries to tell the class something directly, the interaction in the small groups comes to an abrupt halt. Within small groups, the self-directed nature of student talk tends to disappear when the teacher arrives(Harwood, 1989).

The management of cooperative learning requires the teacher to deal with instruction that has become quite complex; instead of the whole class working on the same task, there may be as many as six or seven groups working at their own pace, or in some cases each group is working on a different task. The sociologist refers to the latter pattern of work as a highly differentiated technology. What do teachers do when faced with such a complex mode of instruction? In a study of complex instruction, involving discovery learning with multiple learning centers and students permitted to move on to new centers when they finished their worksheets at the previous center, there was considerable variability in the number of learning centers in operation (Cohen & Intili, 1981). Some teachers simplified the technology by operating only three learning centers each with an adult (a teacher, an aide, and a parent volunteer) directly supervising a center. Clearly, some teachers were unable or unwilling to delegate authority, that is, to "let go" and to allow the children to solve problems for themselves. If the teachers were unable to delegate authority(as measured by the number of students under direct adult supervision), there were fewer learning centers in operation, the percentage of students talking

and working together was lower, and, as a consequence, the average learning gains were lower. Those classrooms with the greatest learning gains were precisely those where teachers were successful in delegating authority so that more children could talk and work together at multiple learning centers.

The larger the number of groups that a teacher is trying to manage, the lower the probability that she will use direct instruction and direct supervision in which she exerts detailed control over how tasks are executed (Cohen, Lotan, & Leechor, 1989). Moreover, when there are a larger number of groups, direct supervision is unrelated to student disengagement(Rosenholtz, S.H., 1981). When multiple groups are in operation, lateral relations or talk between the students predict engagement rather than direct supervision.

Cooperative learning can become complex along other dimensions besides the differentiation into multiple groups and materials. As discussed above, the nature of the tasks given to the groups can be relatively routine procedures or problems with ill-structured solutions. If interaction is critical because the small group task is a problem with an ill-structured solution, the extent to which the teacher applies direct supervision will diminish the possibilities and opportunities of students communicating with each other. If the teacher, as an authority figure, takes responsibility for their task engagement, students will not assume responsibility for solving problems related to the task. In two data sets, based on classrooms using complex instruction, Cohen, Lotan, & Leechor (1989) found that the rate at which the teacher used forms of direct instruction when students were working in small groups was negatively related to talking and working together among the students. Direct supervision is the obverse of delegation of authority. This research provides support for a general sociological principle formulated by Perrow(1967).

Once technology has become more uncertain, two necessary changes should be made in order to maintain or increase organizational productivity: delegation of authority to the workers; and more lateral communication among the workers. In educational terms, this means that when cooperative learning tasks are non-routine, problem-solving or discovery tasks, it is necessary for the teachers to avoid direct supervision and to foster talking and working together within the small groups.

Learning to delegate authority to groups is not an easy task for teachers. When Cohen and Intili(1981) found, as reported above, that teachers were afraid of losing control of the classroom and thus reduced the number of groups so that they could use direct supervision, they responded by developing a new system designed to assure the teachers that they could still be in control of the classroom even though the authority was delegated to groups of students. They required that students move on to a new learning center only when the whole group had completed its task and worksheet. Furthermore, behavior was controlled through a system of systematic training in cooperative norms and the allocation of a different role to each group member. The introduction of this new system resulted in a significant increase in the percentage of students in small groups and a reduction in the use of direct supervision, along with a sharp increase in the proportion of students observed talking and working together on the task(Cohen & DeAvila, 1983).

Implications for Staff Development and School Organization

The implementation of cooperative learning of any sophistication has major implications for staff development, for the ways in which teachers work together and for the principal's role. Researchers have concluded that teachers require significant support from staff developers, from the principal and from colleagues if implementation is to be significant and sustained.

Preparation of Teachers

Preparation of teachers for cooperative learning varies between short-term workshops (one-day) offered by districts and professional conferences to elaborate educational programs that may last for more than a year. Teachers may attend workshops as individuals or as teams from schools; in some cases, peer support teams work together on problems of planning and implementation following the initial staff development. One important way in which the more ambitious programs vary is whether or not they include classroom follow-up with feedback to the teacher from peer coaches or from staff developers.

Length and Complexity of Training. Although short-term training is very widely used, this reviewer found no published research on its effectiveness. However, evaluations of more ambitious programs suggest that longer preparation is more effective in helping teachers to implement cooperative learning. Moreover, even with the most sophisticated and lengthy programs, a significant number of teachers fail to implement. Of course, in evaluating the effectiveness of programs, it is important to consider whether the strategies being taught are relatively routine or whether they demand extensive teacher thinking, planning, and non-routine decision making.

For example, Sharan and Hertz-Lazarowitz (1982) prepared 50 teachers in a variety of small group teaching methods that involved small group planning, discussion, and investigation, a repertoire that was demanding of teachers' skills, especially since there were no prepared curricula. Their workshops incorporated basic principles of staff development that have been effective for other classroom strategies. These included (1) working with staffs as intact susbsystems; (2) emphasizing experiential learning during the workshop; (3) asking for voluntary

participation; (4) having teachers develop learning materials; (5) providing sustained and systematic follow-up of the teachers in their classrooms by the project staff. There was a total of 60 hours of workshop experience. Each school had its own workshop trainer and school consultant. In the second year, the project used teacher self-help teams for planning mutual observations and feedback by teammates based on objective observation schedules.

Despite this carefully constructed and lengthy program, the researchers did not find significant implementation in the first year. After an initial workshop at the beginning of the second year, teachers used these methods 17% of the time. There was a significant increase in implementation during the second year so that by the end of the year, teachers were implementing cooperative learning techniques 37% of the time. Of the 50 teachers, 65% implemented the strategies on a fairly high level. These findings illustrate the investment in time and expertise that may be necessary for the more demanding strategies.

Workshops for complex instruction embody these same general principles for staff development used by Sharan and Hertz-Lazarowitz as well as a practicum in which teachers can practice on a class of students and a prepared curriculum. The initial workshop lasts two weeks and is followed up by nine classroom observations and three feedback visits to each classroom teacher, as well as a one-day workshop during the school year. Under these conditions, it is possible to obtain consistent implementation of complex and demanding strategies for cooperative learning with almost all the teachers(Cohen & De Avila, 1983). Teachers prepared in this way maintained high-quality implementation for up to five years after the initial year of instruction(Dahl, 1989).

A staff development program evaluated by Talmage, Pascarella, & Ford (1984) had

somewhat less demanding objectives for teachers. They were to learn how to set up cooperative tasks with a clear division of labor in which each member of the group was responsible for contributing one part of the final product. Teachers participated as a school team with their principals in a monthly workshop that did not involve classroom follow-up. Differences between the classroom implementation of these teachers and a no-contact set of controls was only significant for those teachers who participated in the monthly sessions for three years. However, each additional year of experience with workshops had a consistent positive effect on student report of a cooperative climate.

Staff development programs also vary in the emphasis placed on the theoretical and research underpinnings of the specific instructional strategies that are taught. Lotan (1985) developed measures of the teachers' overall understanding of the theoretical concepts underlying the approach to cooperative learning called complex instruction. She found that this measure of understanding was significantly negatively related to an observational measure of direct supervision; in other words teachers who understood the theory better were better able to delegate authority. In this and other data, Ellis and Lotan(1991) showed that the same index of understanding was positively and significantly related to the frequency of non-routine behaviors such as status treatments, giving specific feedback, and talking about children's thinking. A fundamental understanding of the underlying theory permits teachers to move away from direct supervision and to take on new and more challenging teacher behaviors that are critical when small groups are working on highly uncertain, conceptual tasks.

Collegial Interaction and Support. In an effort to develop lower-cost staff development that did not involve teacher educators providing direct evaluation and feedback to teachers,

Putnam (1985) provided for follow-up with peer support teams and with self-evaluation/documentation by teachers that was mailed to the teacher educators for comment. Putnam contrasted a small sample of teachers who reported extensive implementation with and without the support of peer teams. Those who had worked with peer support teams were observed doing a better job of delegating authority to groups while those who worked without peer support tended to assume responsibility for maintaining the flow of activities. The peer-supported teachers were more self-critical and ranked their participation in the support group as highly influential in this success. The groups met weekly, served as a forum for problem solving; members saw each other teach via videotape. However, these peer support groups are difficult to establish and maintain. Only 26% of the 46 teachers studies reported that they had worked on teams that continued to meet and support team members (Putnam, 1985).

On the basis of an evaluation of study group teams following a workshop on cooperative learning using the Johnson and Johnson model, Munger(1991) recommends more time be set aside for these activities. About a third of the 25 teachers interviewed rated the study group team as the support structure with the greatest influence in comparison to 48% who ranked the staff development specialists as the most influential support structure. These study groups appear to have suffered, in addition, from lack of a formal agenda.

Just as students working on an uncertain task benefit by talking and working together, so do teachers who are learning to manage more sophisticated forms of cooperative learning. In a deliberate attempt to increase the reciprocal interdependence between teacher and aide(Cohen, & Intili, 1982), a special workshop helped the teams to conduct meetings in which the aide was expected to bring in information, to identify problems, and to make suggestions. The teacher was

expected to do the same, and in addition, had the final decision making responsibility and the responsibility to make those decisions clear to the aide at the end of the meeting. Aides were paid to attend meetings and the meetings of the five teacher-aide teams in the treatment were monitored. The average rate of talking and working together was significantly higher in classrooms of these teams than in the classrooms of the four teacher-aide teams who were not so treated.

When teachers and aides confer in the classrooms, it does not have the same favorable effect on implementation as when they have systematic planning meetings(Mata, 1985). Mata found a significant positive correlation between teacher-aide communication in the classroom and the occurrence of management problems, the opposite of her prediction. Her in-depth knowledge of these teachers and classrooms suggested that management problems were occurring when there had not been adequate planning ahead of time. Those teams that communicated in team meetings and had developed a clear division of labor had the most favorable implementation. However, in this as in other studies, the school schedule makes it difficult to establish and maintain regular team meetings.

Feedback to Teachers. It is very difficult to provide effective feedback to teachers without direct observations of their classes and face-to-face meetings. Putnam's(1985) strategy of feedback-by-mail following workshops yielded only weak implementation of specific cooperative strategies according to teacher report. The part of the workshops that dealt with specific routines and procedures showed stronger implementation that further improved the second year after staff development according to teacher report. Only one-third of the teachers reported having implemented plans for an in-service presentation that they had developed during the workshops.

There are a number of specific problems with having peers observe and provide feedback to each other in the first year of implementation of cooperative learning. The teachers interviewed by Munger(1991) found feedback from staff development specialists far more influential than that from peer coaching. They preferred more expert coaching. Moreover, they specified that peer coaches needed longer observation times and more training on what and how to observe.

When staff developers provide specific feedback, Ellis(1987) found that more feedback sessions with the staff developers were associated with superior implementation of demanding strategies for discovery learning in cooperative groups. Superior implementation was also related to the extent to which teacher perceived the evaluations they received as soundly based(Cohen, & Lotan, 1990). In this study, the index of soundness of evaluation was made up of items concerning teachers' clarity on the criteria utilized, the extent to which they felt that observers got an adequate picture of implementation in their classroom, and whether or not the feedback was sufficiently specific so that they knew how to improve their implementation.

Peer coaching in the first year is unlikely to meet these criteria of a soundly based evaluation. However, teachers who have acquired experience in cooperative learning and specific training in observation and feedback techniques can be an important source of collegial evaluation for each other after the first year. The frequency of such collegial evaluation was associated with the quality of implementation in a study of the survival of cooperative learning over three to five years(Lotan, 1989).

Organizational Support

The school context is a powerful predictor of the extent to which teachers use groupwork in their classrooms. Bliss(1989) found strong school differences in the frequency with which high

school social studies teachers reported using groupwork. High school teachers who used groupwork frequently were likely to work in contexts that included administrative support, on-site expertise and extensive collegial relations. Teachers who used groupwork less frequently wanted more planning time to develop better materials in order to use groups more often.

It is a truism in writings on innovation that the role of the principal is critical. Exactly how does the role of the principal relate to the implementation of cooperative learning? Researchers have demonstrated at least two aspects of the principal's role that are important: managerial skills and instructional leadership. Managerial skills include finding and coordinating resources needed for the new type of instruction. For example, teachers need planning time, time to observe each other's classrooms, and the right kind of space for teaching with multiple small groups. All of this requires that the principal coordinate the demands for time and space with all the other demands for these scarce resources. In addition, when the cooperative learning materials involve many manipulatives , these materials require collection and organization, a task beyond the resources of any one classroom teacher. Cohen and Lotan(1990) developed a path model to test the direct and indirect influence of the principal on the time given to implementation of complex instruction. Teachers who reported that they were given adequate organizational help in obtaining and organizing materials for cooperative learning and teachers who reported that they were given more release time for planning tended to spend more time implementing cooperative learning and covered more units of the curriculum than teachers who received less help and less planning time(Cohen & Lotan, 1990). The impact of receiving organizational help on the time spent implementing cooperative learning was mediated by the teachers' perception of the adequacy of the supply and organization of the curricular materials. Other studies of complex

instruction have also found that coordination by the principal was related to quality of implementation in the first year(Parchment, 1989). Observation of these schools supported these findings: if the principal solved the problems of coordinating materials collection and acquisition, then the teachers were not held up in their instruction by delays related to the materials. Likewise, those teachers who were fortunate enough to be given planning time did not take teaching time out between units to study and plan for the next unit. This resulted in longer average implementation time per week and more units over the year. Principal coordination was also a predictor of the number of units implemented in the years following initial implementation (Dahl, 1989).

Instructional leadership has very specific implications for cooperative learning. In the initial stages of implementation, a teacher can become fearful and discouraged. As a result, she may resist being observed and put off receiving feedback. At this juncture, whether or not she will persist with the process of improving her implementation depends on whether others expect her to follow through with the process of implementation, observation and feedback. Cohen and Lotan(1990) hypothesized that the perception by teachers of expectations held by others for her implementation would predict the quality of implementation achieved. The index of perceived expectations included an item on expectations of the principal that she follow through and implement cooperative learning after the workshop as well as an item on expectations of fellow teachers. The combined index proved to be a significant predictor of the percentage of students talking and working together, a measure of the quality of implementation of cooperative learning. If a group of teachers and/or a principal really makes a commitment to implementing cooperative learning, the effective part of that commitment is very likely the set of expectations that others

will work hard to implement the new strategy for instruction,. Some principals are quite permissive; if a teacher is reluctant to be observed and meet with a trainer for feedback, that is strictly her decision. Other principals let the teachers know directly or indirectly that the district or school has paid for the workshop and support and certainly expects that teachers will go through the whole process. If the principal is active in planning for the workshop, attends the workshop, and becomes knowledgeable about the strategies of cooperative learning, the teachers realize that he or she has every expectation that they will carry through and implement the new methods. In other schools, the expectations of colleagues are more important and the principal stands behind the collegial decision to undertake staff development.

Conclusions on Staff Development and Organizational Support

The distinction between strategies for cooperative learning that are more and less demanding for teachers is a critical one in hypothesizing what kinds of staff development and organizational support are necessary for successful implementation. Strategies that seem to demand less from the teachers include collaborative seatwork and other types of cooperative learning that do not require the preparation of special curricular materials or that structure the interaction in a formularized manner. We would hypothesize that short-term training with isolated teachers from different schools would only be effective with these methods of instruction. We base this proposition on the notion that routine strategies that have a recipe-like character make the least demands on the development of a new teacher role and do not require teacher interaction in order to plan and solve problems with respect to the implementation.

For strategies that are more demanding and require teachers to develop new materials or that require teachers to develop new roles and non-routine decision-making, longer preparation,

intact teams from schools, preparation involving experiential learning as well as theoretical underpinning are necessary. Furthermore, the evidence strongly suggests that follow-up in classrooms with an expert trainer who provides systematic feedback involving evaluations that are perceived as soundly based by the teachers is also a necessary condition for the implementation of these more sophisticated strategies.

Collegial support and interaction can also be effective in improving implementation, but this factor is much more than "teacher talk." Collegial teams not only require release time for systematic conferencing, but one could hypothesize that teacher groups or teams require specific assistance with agenda and useful planning and problem-solving strategies for their meetings. Just as students require preparation for cooperative groups, so do teachers. Observation and feedback from colleagues will be more effective when the person giving feedback has acquired expertise and specific instruction as to how to observe and provide feedback.

When more demanding strategies for cooperative learning are introduced to the school, there is a need for both collegial relations among the teachers and a supportive principal . This need for a "cooperative" school is not simply a matter of the value judgement that what is desirable for the students is desirable for the whole school. There are strong sociological grounds for arguing that as more complex instructional techniques are introduced at the classroom level, the uncertainty that they produce for teachers requires the superior communication and problem-solving that is absent in traditionally organized schools. In addition, these techniques require a commitment on the part of the school administration to supply the time, materials, and leadership that is necessary to support and insure that problems faced during implementation will be overcome. The typical school leaves such instructional problems in the hands of the isolated

classroom teacher, but this will work only if the teaching technology is relatively simple.

There are several implications for practice from this evidence and argument. One is that staff developers would do well to select the schools with which they work very carefully so that they meet the organizational conditions that are necessary for successful implementation. Chaotic schools, schools with extremely high turnover of teachers and administrators, schools that have no spare time for teacher meeting and observation of each other's classrooms, principals who do not have the capacity to coordinate time, space and personnel to support the new forms of instruction, and principals for whom the teachers have no respect -- these are all warning signs to the staff developer. Having selected schools with a modicum of organizational health, it is still necessary to provide preparation and support for the principal, just as important as it is to provide such support for the teacher. There are new aspects to the principal's role that are demanding and difficult and will require instruction and feedback.

Cross-Cutting Issues

As the developers of cooperative learning have accumulated experience in working with teachers and classrooms, several issues have arisen that cut across the categories of this review. One of these issues has to do with curriculum. Does the use of cooperative learning require a change in curriculum that necessitates the adaptation or creation of special materials for the classroom teacher? Or can the teachers be left to their own resources to create lesson plans that will work for small group settings? The second practical issue is one of the type of assessment that can and should be used for cooperative learning. There is not very much research available with respect to these two questions, but their pressing importance dictates the necessity for evaluating what is known and recommending how researchers might think about these problems.

Curriculum. The issue of whether or not it is necessary to create special curricular materials for cooperative learning is one on which staff developers differ. Some have developed elaborate curricular materials while others make preparation of materials part of the initial workshop and still others advise teachers to work together to develop lesson plans. There is practically no research available on this issue.

This review has cited problems arising from giving groups tasks that are usually assigned to individuals. Insofar as this argument is compelling, it is necessary for teachers to develop special tasks for cooperative learning. Collaborative seatwork is undoubtedly so common simply because of the difficulty teachers experience with developing special materials. Slavin has developed special curricula even for methods such as STAD, arguing that the common worksheets are inadequate for achieving curricular goals.

There is a real danger, it would seem, of failing to give teachers the help they need with curricular materials. They have little time, resources, or preparation for the development of such materials. With routine materials, one would predict that students would rather quickly tire of working in small groups. Thus the failure to solve the problem of materials may be one of the causes of the rapid decline of this innovation. Once teachers have had the opportunity to work with well-constructed materials, they may well be able to adapt materials on hand. This is especially true for subject matter specialists who tend to collect materials over their years of teaching that can quite easily be adapted.

If, as we have argued, it is necessary to treat status problems with multiple ability tasks, then teachers will clearly need assistance with the development of activities that require many different intellectual skills. Bower(1990) contrasted multiple ability tasks with cooperative

learning tasks that require primarily linguistic abilities. He worked with high school social studies teachers who were teaching American history. Teachers served as their own control; one class worked with the multiple ability tasks and the other worked with the linguistic tasks in which they discussed interesting questions based on primary source materials. The curricular content and the textbook assignments were the same. Furthermore, both classes were carefully prepared for cooperative learning and both classes used roles within the groups. Results showed that there were far stronger gains as measured by a test in social studies in the multiple ability curricular classes than in the classes with linguistic tasks. The gains made by low-achieving students working with multiple ability curricula were especially large.

Assessment. There was comparatively little research that contrasted various assessment techniques for cooperative learning. In Davidson's review of research on cooperative learning techniques in the teaching of mathematics(1985), he cites studies contrasting small groups examinations to individual examinations. In the two studies in which this was done, the scores of the group exams were significantly higher than scores on the same exams taken individually. There was no significant effect on the individual's final exam of having taken group exams, but group exams were associated with reduced anxiety.

There is evidence for an interaction effect between the individual's competitive or cooperative orientation and the effectiveness of cooperative learning techniques that utilize assessment methods (Kagan et al.,1985). Those individuals who scored high on a measure of cooperative orientation did more poorly in learning spelling in the Teams Games Tournaments method (TGT) than in the STAD method. Similarly, more competitively oriented individuals who studied with the TGT techniques did better than similarly oriented individuals in the STAD

learning treatment. In STAD, students are assessed by weekly quizzes with no direct interpersonal competition. In TGT, in contrast, each week students are assigned to triads and to tournament tables, at which they actively compete against students at similar ability levels from other teams. Competition at tournament tables is intense. In STAD, students maximize group scores by their improvement over their own past scores. Evidently the more intense competition in the assessment of TGT is beneficial for some individuals and harmful for others.

We learn indirectly about assessment of cooperative learning through the multiple studies of effectiveness on achievement tests. The many studies showing favorable results on achievement tests suggest that teachers can use either conventional achievement tests or tests that examine the use of higher-order thinking skills as assessment of learning. The suitability of the test depends on the nature of the cooperative learning strategy, whether focussed primarily on information and application of algorithms or on creative problem-solving and understanding issues from multiple perspectives. Users of cooperative learning need not fear that basic skills will be neglected. Basic skills can either be instrumental in the course of creative problem-solving and discussion or they can be the sole basis of the tasks given to groups.

A promising subject for future research is the effect of cooperative learning that uses creative problem-solving and experimentation on the newest methods of performance assessment. It would seem that the cooperative learning format is a "natural" for producing superior results for the newer methods of assessment, although it will be critical for the tasks given to groups to demand some of the same higher-order thinking as does the assessment. An ideal assessment for students who have solved problems in groups is the assignment of a group evaluative task in which the group tries to solve a problem together and receives some evaluation for how well they

have done. Aside from the work of Ehrlich(1991), who used a group assessment for research purposes and the work on group exams in mathematics, there has been no research on group problem-solving as a method of assessment.

Teachers often attempt to assess the individual's contribution to the group by observing how the individual members participate in the course of the groupwork. Given what is known about status problems within the cooperative learning setting, this is an illegitimate mode of assessment. Low-status individuals are frequently ignored when they make contributions and are often shut out of interaction and access to materials. It would hardly seem fair to hold the victim responsible for such failure to participate. In contrast, teachers sometimes assess the group as a whole for how well they work together; or they may ask groups to assess their own group process. Such assessment can be very effective in improving group functioning.

Conclusion

The research on cooperative learning has been moving past the necessity to defend this strategy as a legitimate method of instruction that can help students to learn. As the research has developed, there has been a tendency to become mired in ideological conflicts concerning the desirability of competitive elements embedded within cooperation and the use of extrinsic vs. intrinsic rewards. Additionally, as questions are raised about what types of cooperative learning are the most productive, they tend to be answered by unconditional generalizations and by research designs that compare one of the popular models of cooperative learning with another.

By focussing on factors that make for a productive discourse within small groups, this analysis has raised questions concerning the kinds of discourse that are productive of different types of learning. Furthermore the focus has been on the factors that affect discourse rather than

factors that directly impact achievement gains. In other words, with interaction the central issue, the question becomes: What kinds of interaction are necessary for different kinds of outcomes?

Once the practitioner decides on the objective of cooperative learning, he or she will understand what kind of interaction should be fostered. Various strategies for dividing the labor, using roles, scripting the interaction, treatment of status problems, etc., should be chosen with an eye to fostering the desired outcomes and type of interaction in the group. This approach gets away from choosing between the complex models for cooperative learning that have dominated the field and moves practitioners to thinking for themselves about the elements they want to use given their group task and teaching objective. Practitioners have already eclectically combined features from various models and have combined cooperative learning with familiar elements from traditional instruction. Given what has been learned about the thorough preparation and organizational support necessary for implementation of more sophisticated strategies, teachers are unlikely to use cooperative learning with conceptual discourse and higher-order thinking unless the level of training and follow-up are sharply improved. With proper preparation that includes a good theoretical grounding, teachers can and do maintain the use of these strategies over time. Without this preparation and support, we can expect teachers to fall back upon the simplest strategies of collaborative seatwork.

We do not need more research taking a naturalistic look at groups that function with minimal task instructions, uninspired tasks, and minimal preparation for discourse. Much of the research reviewed reveals a naivete concerning the capacity of uninstructed children to negotiate exciting intellectual meanings with no support for the forms of discourse that lead to productive exchange.

This analysis moves away from the fruitless debates about intrinsic and extrinsic rewards and goal and resource interdependence that have tied the field into theoretical and ideological knots for some time. Instead, research needs to be conditionalized upon whether or not the assignment given to the group is a true group task and whether or not it is a problem with an ill-structured solution. Research on the effects of interaction needs to be conditionalized according to these dimensions. Likewise, research on structuring the interaction should be conditionalized. For example, it may be hypothesized that too much structuring may impede conceptually-oriented interaction, particularly if it micromanages what group members are to say and thinking about. The same type of structure may be highly productive when groups are trying to learn a lesson the teacher has imparted or to absorb information on a given topic.

Similarly the consequences of division of labor should be studied under varying sets of task conditions. Even the relationship of reward contingencies to achievement may vary as a function of whether the task is a true group task with high intrinsic interest or not. To sum it up, the focus on the task and the nature of the interaction has the potential to assist researchers, staff developers, and practitioners in moving on to a second generation cooperative learning that is more firmly based on detailed knowledge of what makes these groups productive.

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